2006 Monongahela National Forest Hemlock Woolly Adelgid Survey

Monongahela Forest Phone Numbers

Supervisor's Office - Forest Headquarters
200 Sycamore Street
Elkins, WV 26241
304-636-1800 (Voice & TDD)
One block east of Rt 219 at the Iron Horse statue in downtown Elkins.

Cheat Ranger District (1)
PO Box 368
Parsons, WV 26287
304-478-3251 (Voice & TDD)
On US Route 219 just east of Parsons

Gauley Ranger District (2)
932 North Fork Cherry Road
Richwood, WV 26261
304-846-2695 (Voice & TDD)
One mile east of Richwood on Rt 39/55

Greenbrier Ranger District (3)
Box 67
Bartow, WV 24920
304-456-3335 (Voice & TDD)
On Rt 92/250 just east of Bartow

Marlinton Ranger District (4)
PO Box 210
Marlinton, WV 24954-0210
304-799-4334 (Voice & TDD)
On Cemetery Road off Rt 39 at the eastern edge of Marlinton.

Potomac Ranger District (5)
HC 59, Box 240
Petersburg, WV 26847
304-257-4488 (Voice & TDD)
1.5 miles south of Petersburg off Rt. 28/55

White Sulphur Springs District (4)
410 E. Main Street
White Sulphur Springs, WV 24986
304-536-2144 (Voice & TDD)
On Rt 60 in White Sulphur Springs

Morgantown Field Office
180 Canfield Street
Morgantown, WV 26505
304-285-1503
Rick Turcotte
Office 304-285-1544
Cell: 304-376-2951
Home: 304- 594-3353

Equipment needed:

- GPS unit
- Compass
- 10 factor Prism
- Maps and Datasheets
- Forest Service Keys (Sign out a Greenbrier Ranger District)

While sampling on the Monongahela National Forest, the forest asked that you check in with the District offices before you sample (Phone numbers above). This is good advise since many of the sites may not be accessible using just your forest keys. You are on your own as to the order you do the sites. If at any time you have question call me.

About the plan:

The plan is statistically based so that the reliability of estimates can be defined. Yet, it was designed to be relatively straightforward in its execution and flexible enough to accommodate various sampling goals.

This sampling plan was created using national forest stand data. Only stands defined as "hemlock" were selected and a subset of those stands with road access was selected. When you arrive on the site, roughly divide the stand into four blocks using the maps included in this booklet. The only measurements required are for the 10 factor prism plots.

About the insect:

Native to Japan, the hemlock woolly adelgid (*Adelges tsugae*) (HWA) is a pest of eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*) (Onken et al. 1999), both of which are considered highly susceptible to the adelgid, with no documented resistance (Bentz et al. 2002). The latter tree species is found only in the southern region of the Appalachian Mountains (Onken et al. 1999). The HWA is currently established in 16 Eastern States from Georgia to Maine, and tree decline and mortality have increased at an accelerated rate since the late 1980s. For example, in the Shenandoah National Park, hemlock crown health has declined since the early 1990s. In 1990, greater than 77 percent of the hemlocks sampled were in an "excellent" condition; by 2000, less than 5 percent were in an "excellent" condition (Blair 2002). A 2001 statewide survey of hemlock stands in New Jersey showed that heavily infested stands had an average mortality rate of 31 percent compared to 4 percent in uninfested stands (Mayer et al. 2002).

The hemlock woolly adelgid is parthenogenetic (an all-female population with asexual reproduction) and has six stages of development (the egg, four nymphal instars, and the adult) and two generations a year on hemlock[1]. Each adult adelgid can produce

[1] The hemlock woolly adelgid also has a winged form, the sexuparae, that is produced by the spring generation. This form must complete part of its life cycle on spruce. The apparent lack of a suitable spruce host for this form in Eastern North America results in a substantial loss of adelgids each year (McClure 1992b).

between 50 to 300 eggs in its lifetime (McClure 1989, 1995). Although mortality in HWA populations is commonly between 30 to 60 percent (McClure 1989, 1996), the reproductive potential of this insect remains high. Mortality is generally attributed to three likely causes: 1) failure of first instars (crawlers) to find suitable hosts; 2) rapid temperature changes and an extended period of cold temperatures that coincides with a susceptible period of development for the adelgid; 3) a sufficient loss in the nutritional quality and quantity of the food source, which leads to an increase in the proportion of the sexuparae form (McClure 1996, Onken et al. 1999). Adelgid feeding can kill a mature tree in about 5 to 7 years (McClure et al. 2001). This tiny insect (~ 1 mm) feeds on all age classes of hemlock, from seedlings to mature, old-growth trees. Dispersal and movement of HWA are associated with wind, birds, deer, and other forest-dwelling mammals. Humans also move the adelgid on infested nursery stock and during logging and recreational activities (McClure 1995). Natural enemies capable of maintaining low-level HWA populations are nonexistent in North America (Montgomery and Lyons 1996, Van Driesche et al. 1996, Wallace and Hain 1998).

Hemlock woolly adelgid on the underside of hemlock branches showing woolly ovisacs.

HWA was first reported in the Western U.S. in the 1920s (Annand 1924, McClure 2001). HWA populations on western tree species, including western hemlock (*Tsuga heterophylla*) and mountain hemlock (*T. mertensiana*), appear to be innocuous; these tree species are believed to be resistant because little damage has been reported (McClure 2001). Unfortunately, both tree species are of limited value for hybridization and planting due to their poor adaptation to the east coast environment (Bentz et al. 2002). In the East, HWA was first reported in 1951 near Richmond, Virginia. It was initially considered to be largely an urban landscape pest and was controlled using a variety of insecticides applied with ground spraying equipment. Observations of the adelgid were periodically reported in several Mid-Atlantic States in the 1960s and 1970s but it was not until the 1980s that HWA populations began to surge and spread northward to New England at an alarming rate. By the late 1980s to early 1990s, infestations of HWA were reported to be causing extensive hemlock decline and tree mortality in hemlock forests throughout the East (McClure 2001).

The purposes of this plan are:

- To provide a minimum detection threshold whereby HWA can be detected with 75 percent reliability in hemlock stands where at least 2 percent of trees are infested.

- To make a efficient determination of the percentage of the trees infested within a stand at 0.25 precision level, the level commonly used for management purposes.
- To measure the impact of HWA within the stand using variable radius plots

What to look for:

Look for the presence or absence of white woolly masses of HWA at the base of needles on the underside of hemlock branches. Hemlock woolly adelgid produce a white woolly coat that is easily observed because it contrasts with the hemlock foliage. It does NOT matter if the HWA are alive or dead. Counting is NOT required. HWA are specific in their appearance and location. If it doesn't look like a typical HWA white woolly mass, it probably isn't one. The number of HWA on a tree is lower when fewer trees are infested. So, if you're not finding anything, then look more closely.

Where to look:

Only select trees where branches can be reached from the ground. Examine the underside of the last meter of foliage on two branches that are on approximately opposite sides of the tree. If HWA is found on the first branch, do NOT examine the second branch. Although the sample branch must have some needles, do NOT discriminate in branch selection based on foliage quality.

How many trees to examine:

- A minimum of 15 but no more than 100 trees must be examined for the presence or absence of HWA depending on how many positive trees are being found.

How to look:

Identify a stand that you want to survey and break the stand into roughly 4 equal sized blocks (do the best you can) of 25 trees each (100 total if needed). Don't spend much time doing this. Simply get a feel for the area and say OK here will be a block, another will be that way, another off over there, etc. Draw a rough outline of your blocks on the maps.

1) Go to a central point of the first block you intend to sample and arbitrarily select your first tree to examine. Trees must have 2 branches that can be reached from the ground.
2) Select a branch and closely examine the underside of the terminal meter of foliage for the presence or absence of HWA white woolly masses at the base of hemlock needles. If HWA are found, mark the data sheet accordingly (in the "Sum HWA Trees" column add 1 for HWA present) and go to step 4.
3) If no HWA were found on the first branch, select a second branch on the opposite side of the tree and examine as before. Mark the data sheet (0- if no HWA found and a 1 if HWA is present) and go to step 4. **NOTE: The data recorded is a running tally (sum) of the number of trees positive for presence of HWA.**

4) Look at your datasheet to ascertain the random direction to follow to select the next tree. Pace out approximately 10-15 single-step paces in the direction indicated and select the closest tree with two branches that you can reach. Don't get carried away being too exact with your cardinal directions; it doesn't matter much, just shoot and go. The same goes for the distance to the next tree.
5) Examine the tree for HWA as in steps 2 and 3.
6) If HWA are detected, mark the data sheet by increasing the running tally by 1. If none were detected, re-enter the past tally number.
7) Repeat steps 4-6 until at least 15 trees are examined and a decision can be made based on the criteria below:
    a. If NO HWA were found then repeat steps 4-6 until either HWA are detected or 100 trees are sampled. Go to (b) once HWA are detected.
    b. If the running tally count is < the stop threshold, then repeat steps 4-6 until the threshold is reached, entering new blocks as indicated.
    c. If the running tally count < the stop threshold after 100 trees are sampled stop sampling.
    d. If the running tally count is $\geq$ the stop threshold, STOP surveying the site.

Prism plots:

When you are roughly in the center of the block (Mark your position on the map and write the GPS coordinate on the datasheet) and put in a prism plot (just a reminder with a prism you swing around the prism which is the center point). Even if you have reached the threshold for that site put in a prism plot at the center of each block.

- Tally by species, classify as alive or dead, and the size class* of all the "in trees" (Label datasheet 1 of X , 2 of X, etc this makes it easier to track which sheet goes with which block).

*

Class	Size(dbh)
1	0-5.9"
2	6-11.9"
3	12"+

If you have any questions etc, give me a call at Home (304) 594-3353

Frequently asked questions:

- "I didn't find a tree at the end of the paces." Pick the closest suitable tree.
- "The plan says go NE and there is a lake." Choose another direction do this anytime you run into an obstruction i.e. cliff, cow pasture, lawn.

- “Foliage quality is low and the needles are sparse.” Sample it anyway; the poor quality might be due to HWA.
- “The stand ended.” Head back into the stand.
- “There are no branches on the opposite side of the tree.” Pick the branch farthest from the one already sampled.
- “How come it doesn’t matter if the HWA are dead or alive.” It is very difficult to assess mortality without a microscope. For this reason, the sampling plan was developed without regard to survival status or stage of development. The presence of white woolly masses indicates that HWA have been and will probably continue to be in the area.